EXTREME UNIVERSE SPACE OBSERVATORY (EUSO)

LENS FABRICATION

AT THE MSFC SOMTC

JAMES DRAKE

18-SEPTEMBER 2003

PROJECT EUSO

- Future ISS External Payload
- Employs double sided Fresnel Lens
- Convex, Concave Meniscus
- Final lens diameter to be 2.5 meter

PROJECT EUSO

- Prototype Double Fresnel Lens produced at SOMTC

1.2 Meter Diameter

SOMTC MANUFACTURING

Moore M-40 Diamond Turning Machine

SOMTC MANUFACTURING

Moore M-40 Diamond Turning Machine

SOMTC MANUFACTURING

Moore M-40 Diamond Turning Machine

- Designed and Built by Moore Tool Company
- Built in 1985
- One of two in existence
- 40-inches of travel in X-Axis
- 30-inches of travel in Z-Axis
- Maximum swing up to 112-inches
- Hydrostatic Spindle with 4000-lbs Capacity
- Laser feedback for positioning
- Positional Accuracy of 100-micro inches over full travel
- Modified in 1998 to accept larger diameter parts

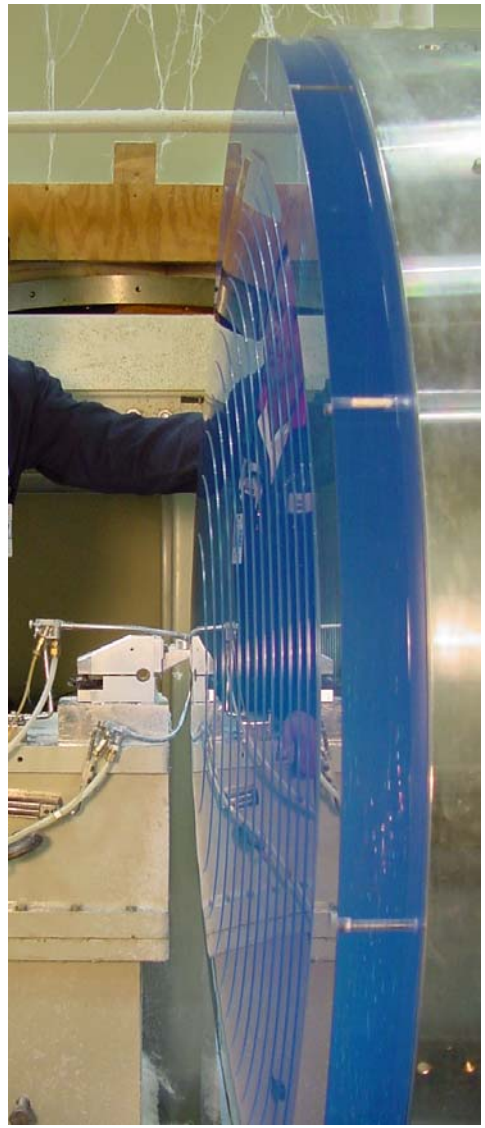
SOMTC MANUFACTURING

Moore M-40 Diamond Turning Machine

MANUFACTURING OF EUSO

PROTOTYPE FABRICATION PROCESS

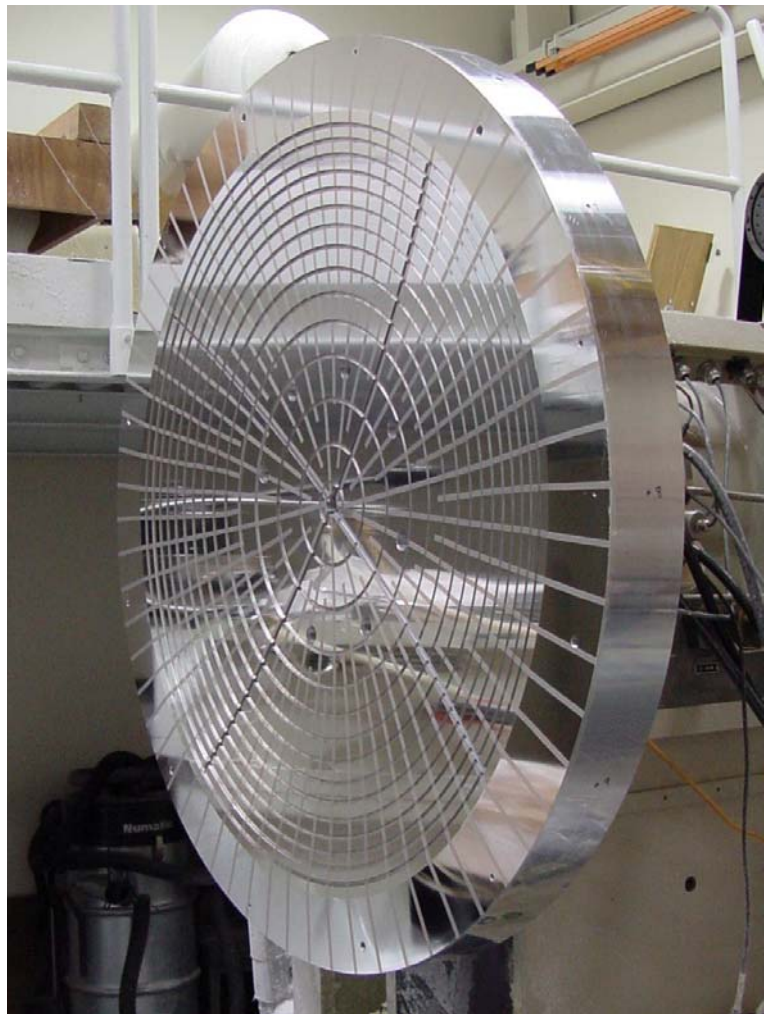
- Raw Material: 4.25-inch thick PMMA
- Convex side turned first:
  - Mount on 3 points of equal height
  - Face flat
  - Flip and hold with vacuum
  - Series of Convex Fresnel Facet Cuts
- Concave side turned second



MANUFACTURING OF EUSO

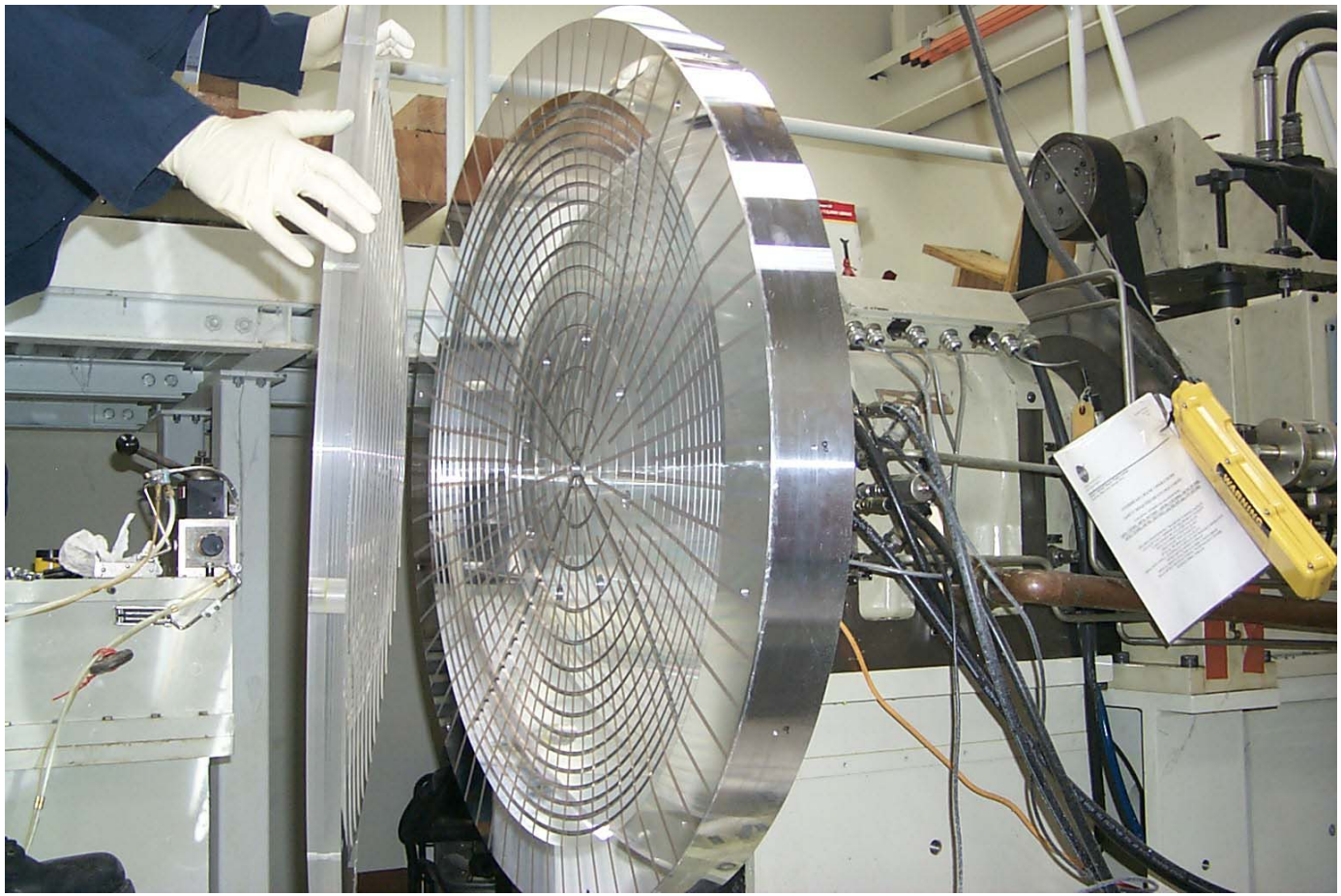
PROTOTYPE FABRICATION PROCESS

- Turning of Concave side required design and fabrication of separate vacuum chuck
- Made from 5-inch thick Aluminum
- Chuck mirrored convex geometry
- Lined with PTFE Skived Film Tape



MANUFACTURING OF EUSO

PROTOTYPE FABRICATION PROCESS
Turning of Concave Geometry



MANUFACTURING OF EUSO

PROTOTYPE FABRICATION PROCESS

Turning of Concave Geometry

MANUFACTURING OF EUSO

PROTOTYPE FABRICATION PROCESS

Turning of Concave Geometry

MANUFACTURING OF EUSO

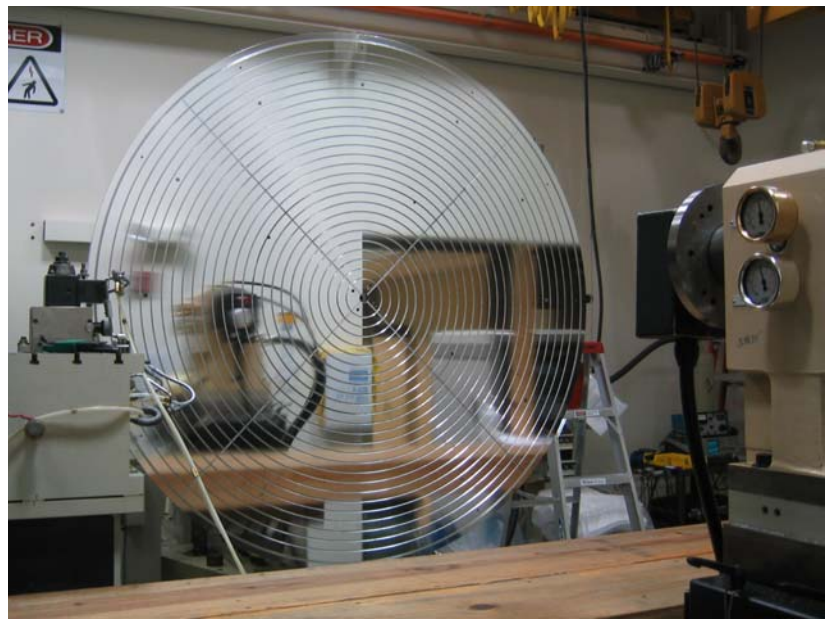
PROTOTYPE FABRICATION PROCESS
Turning of Concave Geometry

- Series of rough dish cuts
- Followed by series of Concave Fresnel Facet Geometry
- Removal from machine

SOMTC MANUFACTURING

RECENT IMPROVEMENTS AND LESSONS LEARNED

- Diagnosis of spindle shaft errors
- Lapping of spindle thrust surfaces
- Motion control system analysis
- Machine vibration analysis
- Vibration damping methods
- Speeds and feeds testing



SOMTC MANUFACTURING

RECENT IMPROVEMENTS AND LESSONS LEARNED

Vibration Damping Methods:

- Spring belt tension
- Elastomer damping support

SOMTC MANUFACTURING

RECENT IMPROVEMENTS AND LESSONS LEARNED

Current Machine Performance:

Surface Finish RMS Improved:

From: 1200 Å

To: Under 400 Å

Following a continuous process of analysis and improvement